MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2017/2018

TSC 2571 – SCIENTIFIC COMPUTING

(All sections / Groups)

7 MARCH 2018
2.30 p.m – 4.30 p.m

(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of **4 pages** only with **4 Questions.**

2. Attempt ALL **FOUR** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write your answers in the Answer Booklet provided, and **start each solution of a question on a new page.**

4. Show all steps.

Question 1

(a) Given the function $f(x) = x\left(\sqrt{x+\frac{1}{x}} - \sqrt{x-\frac{1}{x}}\right)$

(i) Calculate the value of $f(10)$ by using **six-digit arithmetic** with rounding. **[1 mark]**

(ii) Convert the given function into a form that avoids the **loss of significance.** **[2 marks]**

(iii) Calculate the value of $f(10)$ using the function obtained in part (ii) and **six-digit arithmetic** with rounding. **[1 mark]**

(iv) Taking 0.31623 as an actual value for $f(10)$, find the **absolute errors** for the computed value from part (i) and (iii). **[1 mark]**

(b) (i) Let $f(x) = x^4 - 7x^3 + 18x^2 - 20x + 8$. Is **Newton's Method** converges quadratically or linearly to the root $r = 2$ for the given $f(x)$? Then find $\lim_{n\to\infty} \frac{e_{n+1}}{e_n^2}$ (if converges quadratically) or $\lim_{n\to\infty} \frac{e_{n+1}}{e_n}$ (if converges linearly), where e_n denotes the error at step n. **[1.5 marks]**

(ii) Suppose $f(x)$ is a function on interval [1,2] with $f(x) = x^2 + 4x - 10$. Perform **three** iterations using **Newton's method** to reach an approximated root of the equation $f(x) = 0$, starting with initial value $p_0 = 1$. Use **FIVE decimal places** and **show** all the working steps. **[3.5 marks]**

Continued.....

Question 2

[Note: For this question, use **FOUR decimal places** for all the workings.]

(a) Find the actual value for the definite integral $\int_0^2 3^x \, dx$.

[Note: $\int a^x dx = \frac{a^x}{\ln a} + C$]

[1 mark]

(b) Approximate $\int_0^2 3^x \, dx$ by using the **Trapezoidal Rule** with 5 points, and hence find the **absolute error**.

[4 marks]

(c) Approximate $\int_0^2 3^x \, dx$ by completing the following table using ***Romberg algorithm***, and hence, find the **absolute error**.

	m=0	m=1	m=2
n=0	$R(0,0)=$ _____		
n=1	$R(1,0)=$ _____	$R(1,1)=$ _____	
n=2	$R(2,0)=$ _____	$R(2,1)=$ _____	$R(2,2)=$ _____

[4 marks]

(d) Comment on the accuracy of integral obtained in part (b) and (c).

[1 mark]

Continued.....

Question 3

(a) Consider the following linear system:

$$\begin{bmatrix} 2 & 3 & 1 \\ 4 & 1 & 4 \\ 3 & 4 & 6 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 2 \\ 9 \\ \frac{7}{2} \end{bmatrix}$$

(i) Use row reduction technique to find an upper triangular **U** and lower triangular **L** in the **LU factorization** of the given linear system.

(ii) Then find the values of x_1, x_2 and x_3 by using the **L** and **U** obtained from part (i).

[5.5 marks]

(b) Construct the equations for x, y and z of the following linear system. Then compute the two iterations for x, y and z using the **Gauss-Seidel Method**

$$\begin{aligned} 4x + y - z &= 3 \\ 2x + 7y + z &= 19 \\ x - 3y + 12z &= 31 \end{aligned}$$

Copy the following table into your **Answer Booklet** and **complete** it. Write your answers correct to **FOUR** decimal places.

n	x	y	z
0	0	0	0
1			
2			

[2.5 marks]

(c) Find the **eigenvalues** for the following **matrix A**:

$$A = \begin{bmatrix} 2 & 3 \\ 1 & 4 \end{bmatrix}$$

[2 marks]

Continued.....

Question 4

(a) Consider the following **Linear Programming (LP)** problem:

Max $z = x_1 + x_2$

Subject to the constraints

$$2x_1 + x_2 \leq 4$$

$$x_1 + 2x_2 \leq 3$$

$$x_1, x_2 \geq 0$$

[Note: Keep all the values in **simplest fractional form**]

(i) Convert the given LP into a standard LP.

[1 mark]

(ii) Put the standard LP into a table.

[1 mark]

(iii) Then solve it by using the **Simplex method.**

[6 marks]

(b) Consider the following **Non Linear Programming(NLP)** problem:

Minimize $z = x_1 + x_2$

Subject to

$$x_1^2 + x_2^2 = 1$$

Use the method of **Lagrange multiplier** to find values of x_1 and x_2. Then find the optimal value of z.

[2 marks]

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